

# **Fuel Cells and Recycled Water: Sewage-to-Hydrogen Fuel Cell Technology**



**National Fuel Cell Research Center  
University of California, Irvine  
February 24, 2009  
State Water Resources Control Board**

# ELECTRIC POWER

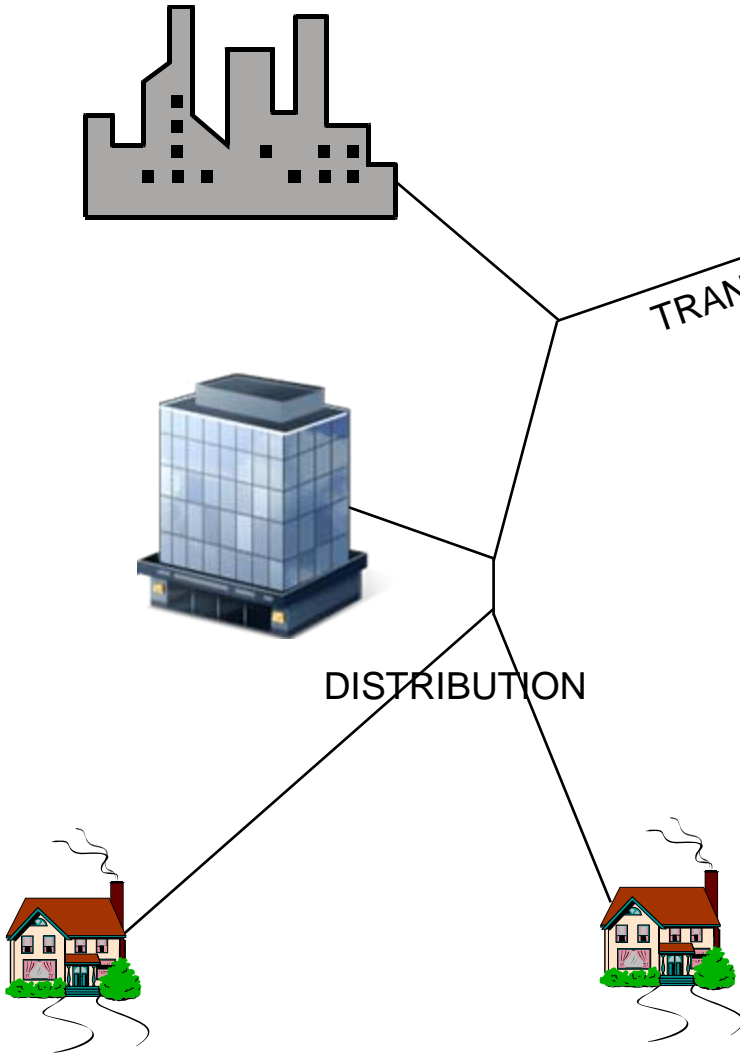
## CENTRAL GENERATION

### COMBUSTION



TRANSMISSION

DISTRIBUTION



- **COMBUSTION**

**FOSSIL FUEL**

**COMBUSTION**

**COMBUSTION  
ALTERNATIVE**

**GENERATOR**

**ELECTRICITY**

- **RENEWABLE ENERGY**

- 80% OF WORLD'S POWER

- **NUCLEAR ENERGY**

- 94% OF WORLD'S CO<sub>2</sub>

- **FUEL CELL ENERGY**

- 50% OF WORLD'S POLLUTANTS

- **DISTRIBUTED POWER GENERATION**



# ELECTRIC POWER

## CENTRAL GENERATION

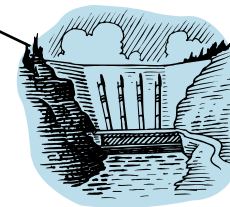
### COMBUSTION



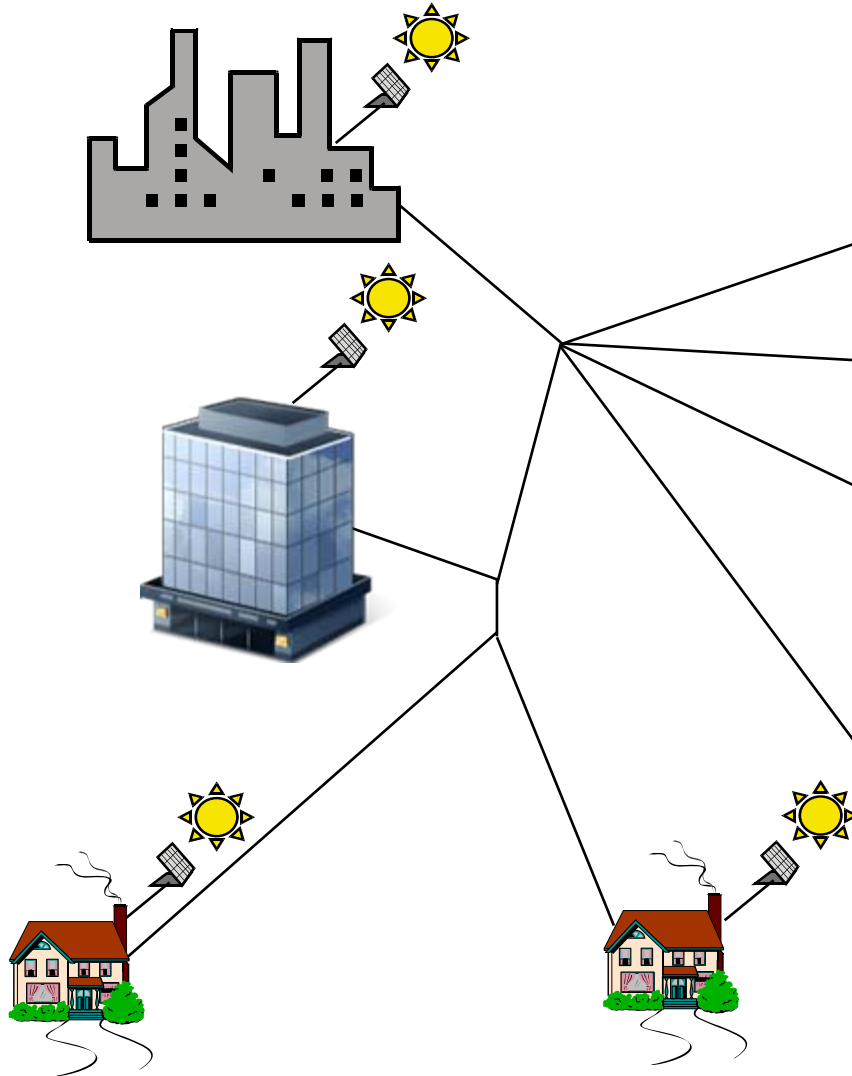
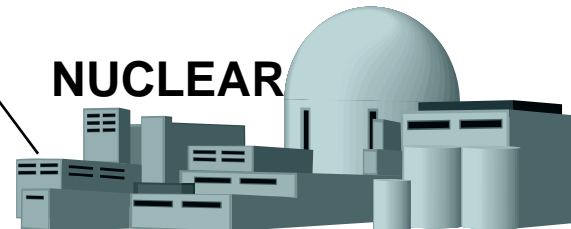
### RENEWABLE



### HYDRO



### NUCLEAR



- **COMBUSTION**

FOSSIL FUEL

COMBUSTION

**COMBUSTION  
ALTERNATIVE**

GENERATOR

**ELECTRICITY**

- **FUEL CELL**

RENEWABLE ENERGY

NUCLEAR ENERGY

FOSSIL FUEL ENERGY

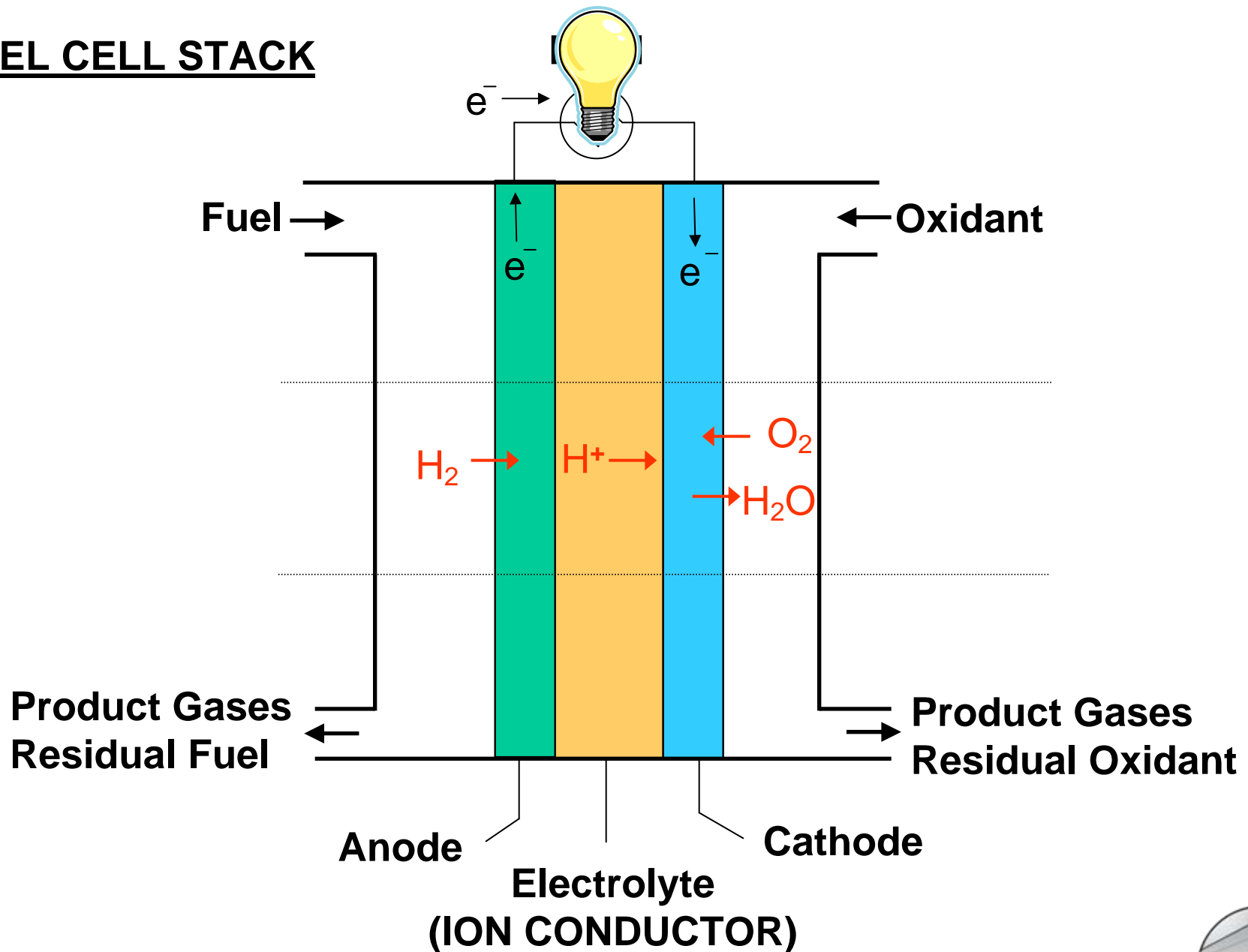
DISTRIBUTED POWER GENERATION

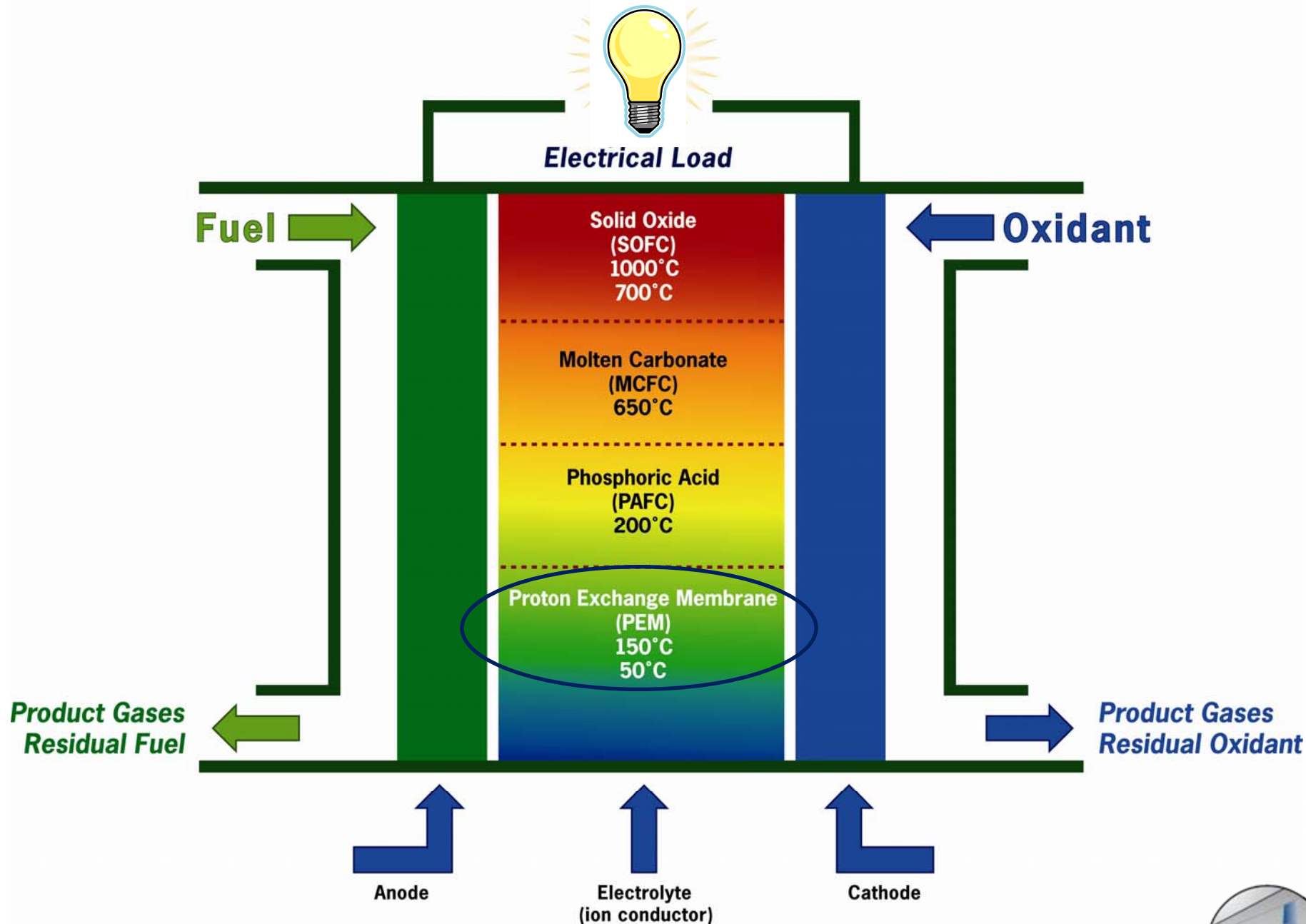
ELECTROCHEMISTRY

**ELECTRICITY**



# FUEL CELL STACK







# FUEL CELL POWER PLANT

STATIONARY

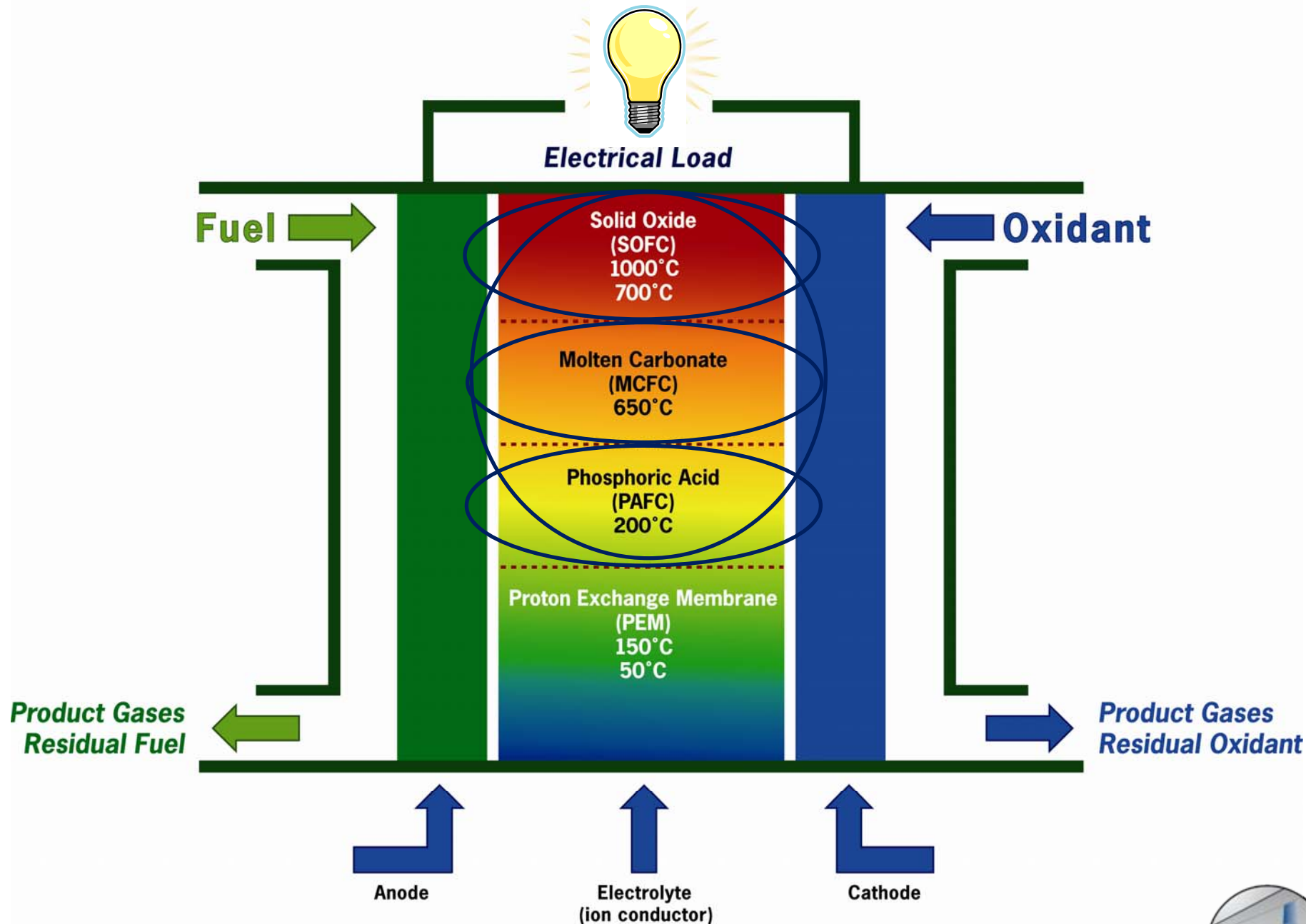


AC

National Fuel Cell Research Center  
University of California, Irvine



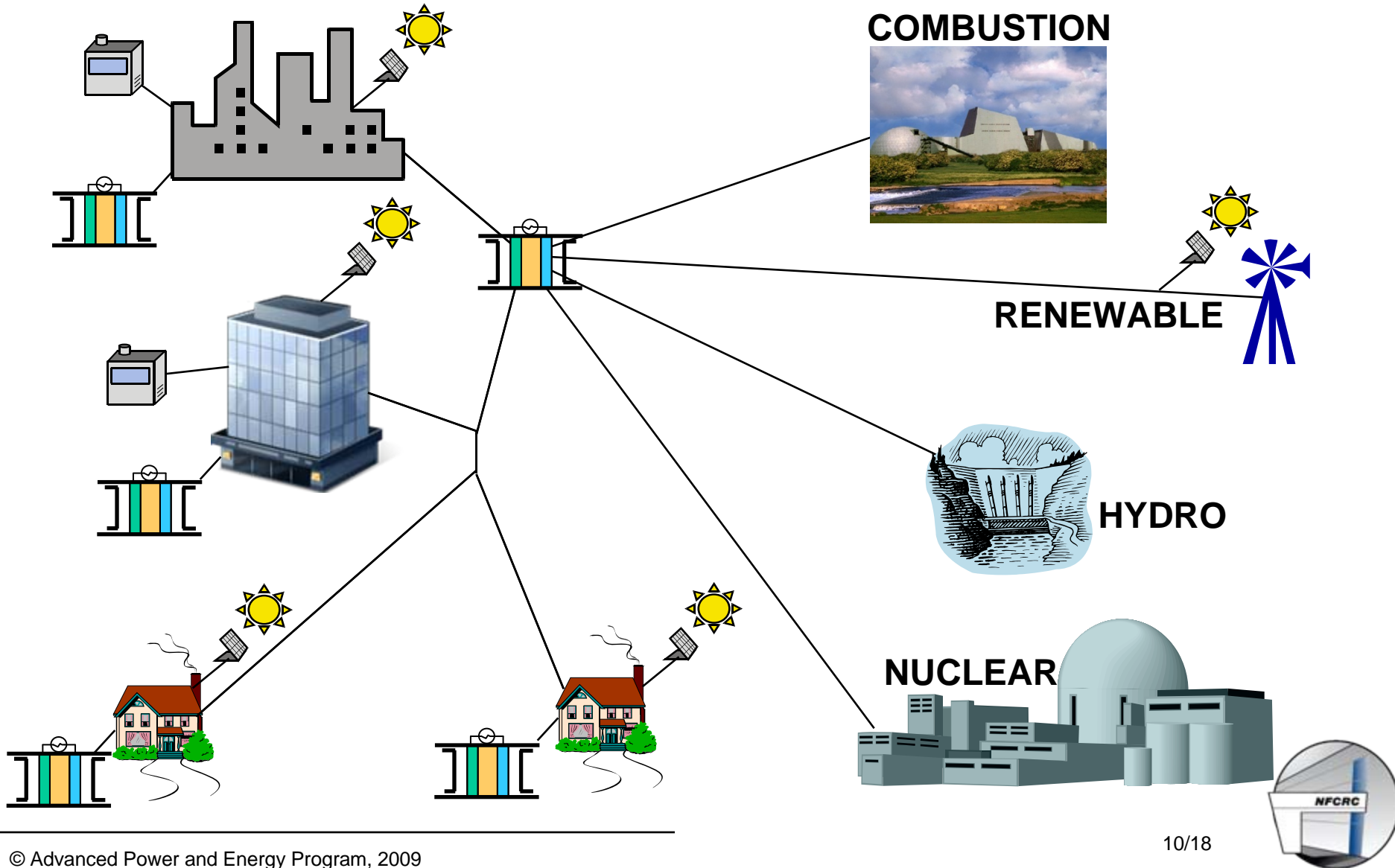




# ELECTRIC POWER

## DISTRIBUTED GENERATION

## CENTRAL GENERATION



# DISTRIBUTED GENERATION

- RELIABILITY

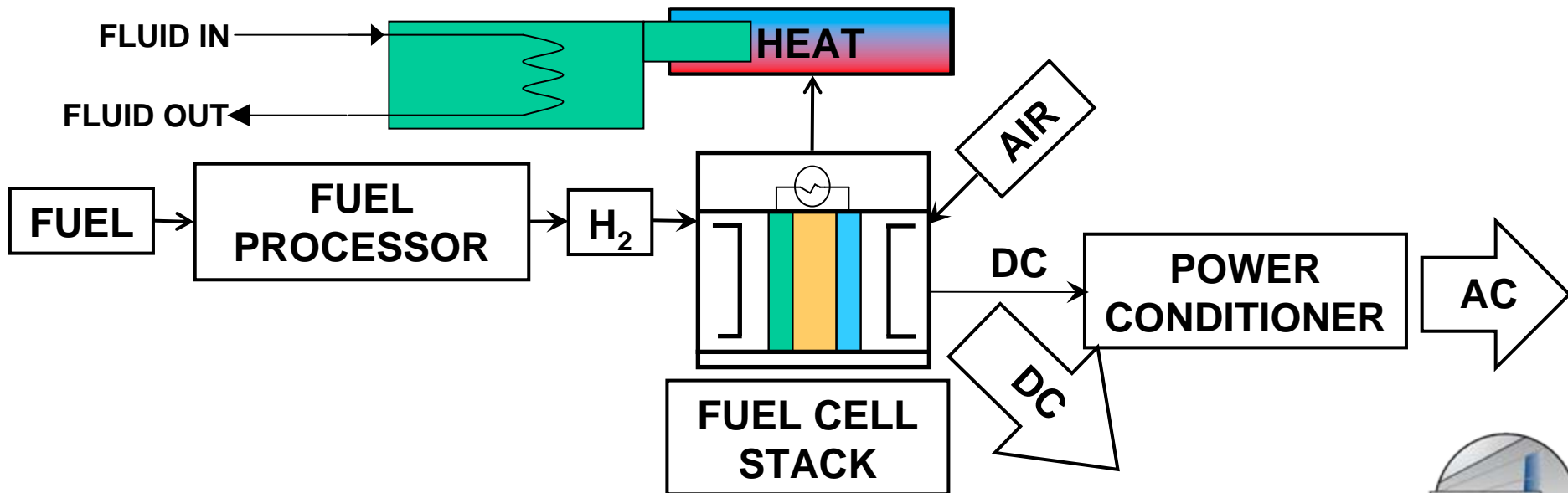
Lights Stay On

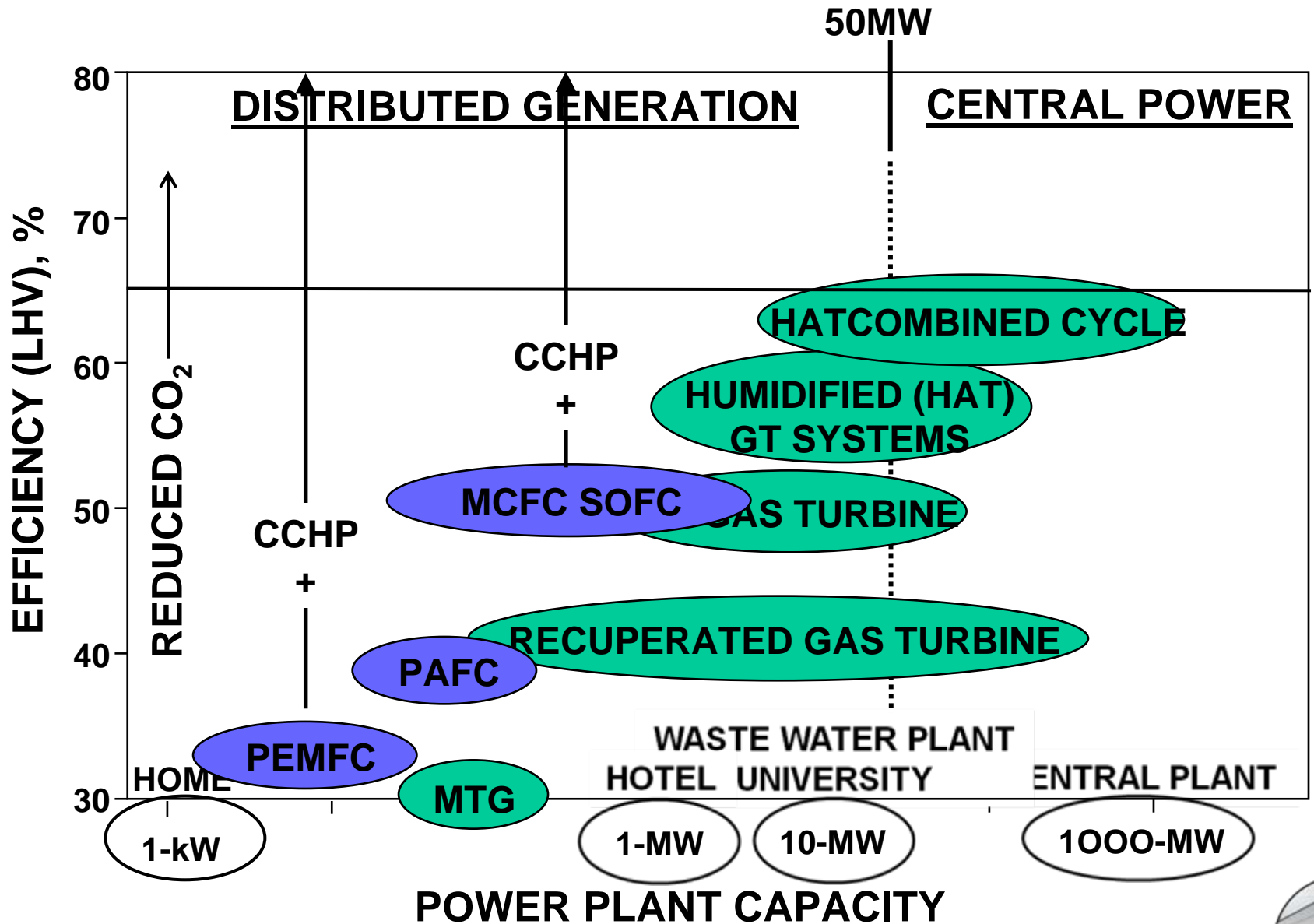
- POWER QUALITY

No Voltage Sags

- RECOVERY OF WASTE HEAT

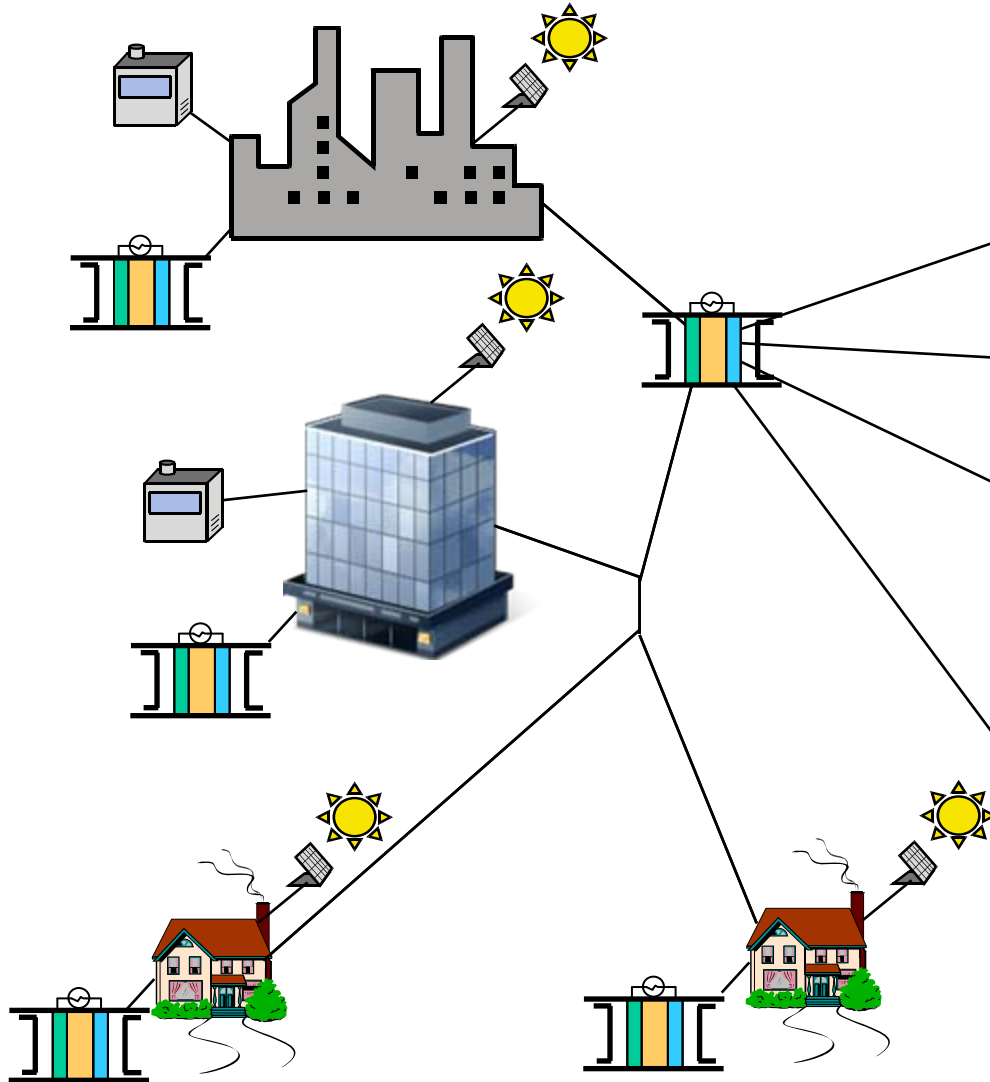
Savings





# ELECTRIC POWER

## DISTRIBUTED GENERATION



## CENTRAL GENERATION

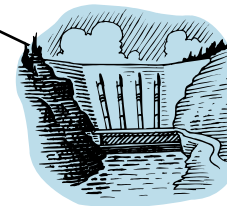
### COMBUSTION



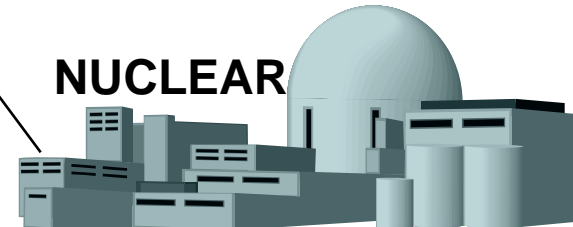
### RENEWABLE



### HYDRO



### NUCLEAR



# **CALIFORNIA STATIONARY FUEL CELL COLLABORATIVE**

**California**

**Stationary Fuel Cell Collaborative**



## **Co-Chairs**

**Mary Nichols, Chair**  
**California ARB**

**Dr. Scott Samuelsen, Director**  
**National Fuel Cell Research Center**

## **Executive Director**

**Mike Tollstrup**

## **Industry Advisory Panel**

**Chris Forbes, Siemens Power**

**[www.stationaryfuelcells.org](http://www.stationaryfuelcells.org)**

**CA Air Resources Board**  
**CA Department of General Services**  
**CA Energy Commission**  
**CA Environmental Protection Agency**  
**CA Public Utilities Commission**  
**CA Resources Agency**  
**CA Trade and Commerce Agency**  
**CA Transportation and Housing Agency**  
**CA Governor's Office**

**U.S. Department of Energy**  
**U.S. Department of Defense**  
**U.S. General Service Administration**  
**U.S. Environmental Protection Agency**

**National Fuel Cell Research Center**  
**LA Department of Water and Power**  
**South Coast Air Quality Mgt District**







Sierra Nevada Brewery  
Chico

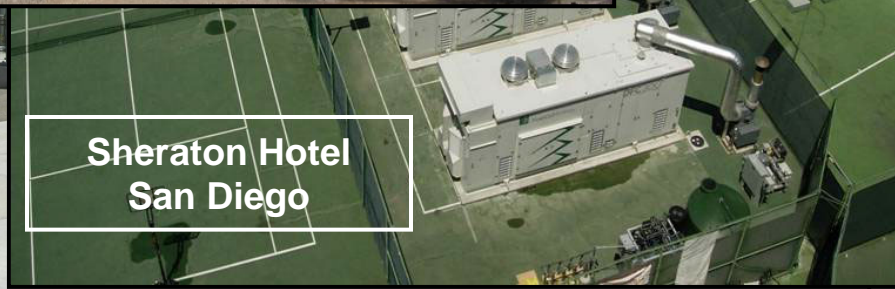
TREATMENT 6.10

City of Tulare  
Anaerobic Digester Gas  
Solar PV

Wastewater Treatment Plant  
Santa Barbara



Sheraton Hotel  
San Diego



SOURCE: CASFCC.ORG

NFCRC



## ENERGY STATION

- Electric Power Generation
- Thermal Power Generation
- Hydrogen Generation

## “GREEN ENERGY STATION”

- Green Electricity
- Green Thermal Power
- Green Hydrogen



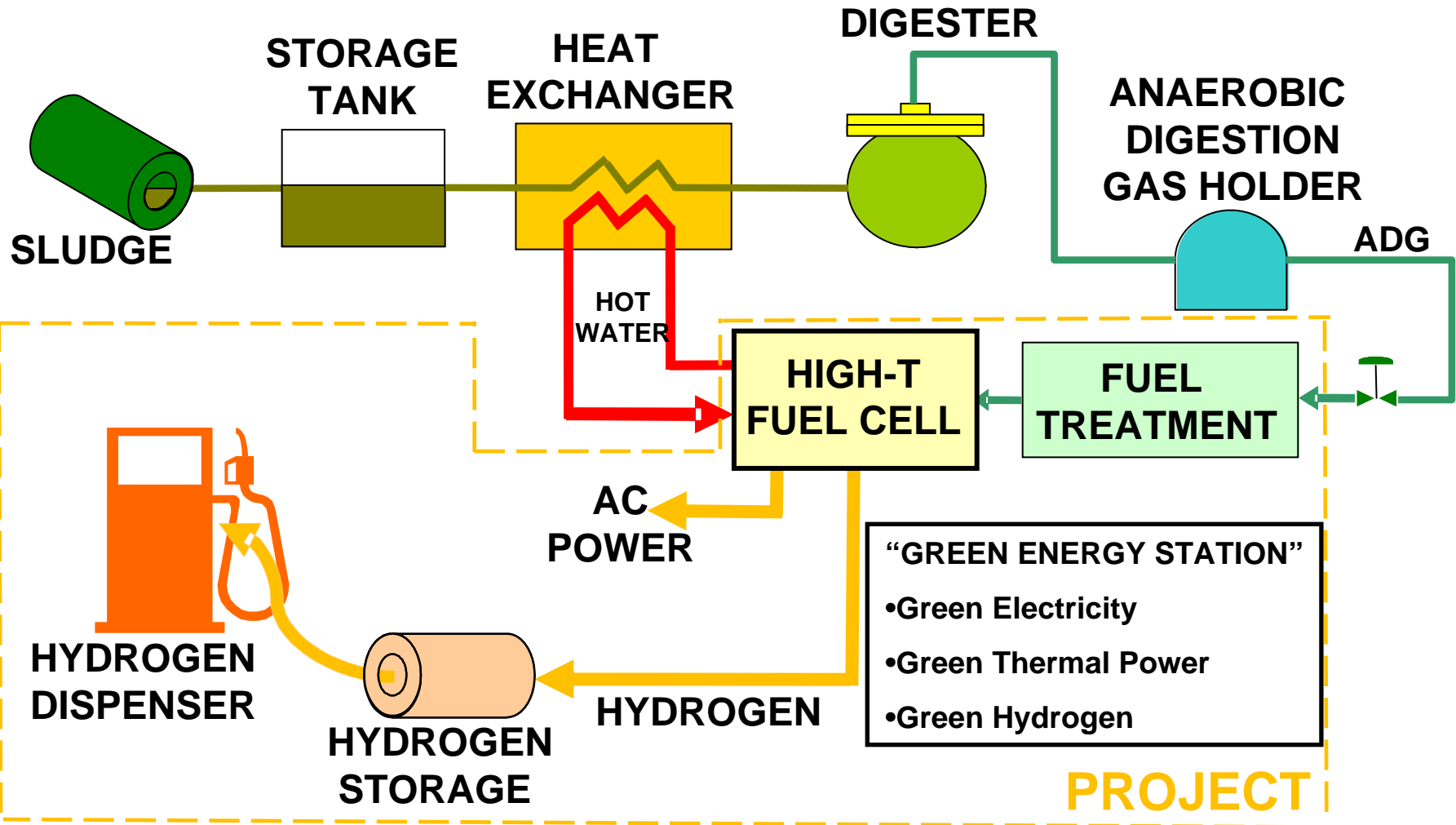
DIGESTER GAS  
LAND-FILL  
GAS

National Fuel Cell Research Center  
University of California, Irvine



OCSD

SEPTEMBER 2009



FuelCell Energy

National Fuel Cell Research Center  
University of California, Irvine



# **Fuel Cells and Recycled Water: Sewage-to-Hydrogen Fuel Cell Technology**



**National Fuel Cell Research Center  
University of California, Irvine  
February 24, 2009  
State Water Resources Control Board**

